SANTA CLARA VALLEY WATER DISTRICT

HYDROGRAPHIC UNIT DELINEATION

Prepared By

Kelly Parton
Water Quality Specialist
Water Quality Unit

under the direction of

Tom Iwamura
Engineering Geologist
Hydrology and Geology Services

Tracy Hemmeter
Senior Water Quality Specialist
Water Quality Unit

OCTOBER 1996

GB
1025
S383 P3
1996
REF
c.2

TABLE OF CONTENTS

INTRODUCTION 1

OBJECTIVES 1

METHODOLOGY 1

PROCEDURE 2

DESCRIPTION

County-wide 3
Santa Clara Valley Ground Water Basin 3
Coyote Valley 5
Llagas Ground Water Basin 5
Bedrock Areas 6

REFERENCES 7

ATTACHMENT A

Map: Hyrdographic Units of Santa Clara County

INTRODUCTION

This report from the Santa Clara Valley Water District's (District) Water Quality Unit presents hydrographic unit delineation of the Santa Clara County ground water basins for the design or revision of monitoring networks. This document outlines the objectives, methodology, and procedure for subdividing the ground water basins into smaller units. Detailed hydrographic unit descriptions and a map are also included.

OBJECTIVES

The District is custodian of the ground water basins in Santa Clara County, and is responsible for protecting and enhancing this resource for beneficial use. Through various ground water monitoring programs, the District collects data for the management of these basins. Thus, the purpose of delineating hydrographic units is to subdivide the ground water basins into smaller units and attribute significance to each. Subserviently, sampling networks can be designed or revised to ensure adequate monitoring within each significant unit.

METHODOLOGY

Hydrographic units are based on the distribution of alluvial materials by historic stream deposition. These units distinguish differing paths of percolation and movement of ground water within the aquifers. The differing paths are directly related to the depositional environment, and the path of surficial water flow. Historic stream channels (which are similar to current conditions), flowed from upland areas and deposited alluvium that eventually formed water-bearing aquifers.

The hydrogeology of hydrographic units varies. We delineated units of significant water storage and water yield, and named them based on the major stream that contributed the alluvium. Larger streams typically contributed larger-grained materials, and subsequently yield a greater quantity of ground water. Units with minor ground water storage and yield were grouped. These units have two or more (usually smaller) contributing streams, and therefore their names do not correspond to a single contributing stream. These units with minor ground water storage and yield are named based on their location in each respective basin (i.e. the Western Small Fans of Santa Clara Valley Ground Water Basin). Note that the name "small fans" does not refer to the size of the unit, rather the quantity of ground water storage or yield. Areas of insignificant water storage and yield, or "dead areas," were also identified.

Unit boundaries were delineated using topographic lines and hydrogeologic conditions (i.e. the potential for a unit to store and yield ground water). Although the map shows two-dimensional unit boundaries, we assume similar lines at depth. Due to subtle changes in historic environments, we also assume interfingering at boundary edges. Current ground water occurrence was not considered a determining factor of boundary delineation, due to anthropogenic influences such as pumping and stream diversion.

The Basin Interior hydrographic unit, although resembling the confined area of the Santa Clara Valley Basin depicted on other District hydrogeologic maps, is smaller and used for the sole purpose of this study. The extension of hydrographic unit boundaries into the confined zone incites the monitoring of both unconfined and confined aquifer conditions in those units abutting the Basin Interior. Furthermore, delineation of hydrographic units beyond the confined zone boundary promotes strategic monitoring of the upper aquifer zone and significant units neighboring the Basin Interior.

PROCEDURE

This section describes the procedure used to delineate hydrographic units in Santa Clara County. Note that all data presented in this report was based on previous studies and existing maps. No field work was conducted for the delineation of hydrographic unit boundaries in Santa Clara County.

The procedure for delineation began with identification of the geologic contact between consolidated and unconsolidated sediment deposits, and bedrock. Lines depicting boundaries between differing geologic contact were drawn on United States Geological Survey 7.5 minute quadrangle maps (1:24000 scale). These lines were based on the *Geologic Map of Late Cenozoic Deposits* (Helley and Brabb 1971). The next step entailed identifying alluvial fans of major contributing streams. The alluvial fans of each stream were identified on topographic maps by the fan-shaped contour lines surrounding each major stream. The major alluvial fans were drawn on the same quadrangle maps used to depict the geologic differentiation. Larger fans were drawn first, as their easily-identified fan contour lines were easier to discern than the smaller fan contour lines. Next, smaller fans were drawn on the maps and grouped with other small fans of similar alluvium and ground water storage and yield. Hydrographic units splaying into the interior portion of the Santa Clara Valley Ground Water Basin were extended as far as the distinguishable fan-shaped contour lines dictated, regardless of the boundary between confined and unconfined zones.

Once the hydrographic unit boundaries were drawn on the topographic maps, they were automated to our geographic information system (GIS). This process involved converting the lines to digital format, and then entering the geographic information associated with each hydrographic unit into table format. Each individual map sheet was digitized separately and then joined together to form one single map, or coverage, of all the hydrographic units in the county. All automation was done on a Hewlett Packard 9000 UNIX system, with ARC/INFO 7.0.4 software. The maps were projected into the California State Plane, Zone 3, NAD 1927 coordinate system.

To ensure unit boundary accuracy, digitized lines of the hydrographic units were overlain by both creeks and topographic contour coverages. If, for instance, Stevens Creek was displayed as flowing outside of the Stevens Creek Hydrographic Unit, then modifications were made. At this time, other detail, such as bedrock islands, was added (drawn on the hard-copy maps and then digitized).

Finally, names were assigned to each unit based on major contributing stream or location within each basin (North, South, East, West) and then entered into the GIS data table to be associated with the completed coverage.

DESCRIPTION

County-wide:

Santa Clara County has three interconnected ground water basins, Santa Clara Valley Ground Water Basin, Coyote Valley, and Llagas Ground Water Basin. All three basins are filled with unconsolidated alluvial material deposited as fans by creeks entering the basins from the mountainous areas. In general, creeks deposit coarser, more permeable alluvium at the head, or apex, of the fan. Finer, less permeable alluvium is deposited further down the fan. Alluvium is also better sorted and more stratified (layered) down the fan, often forming alternating layers of water-bearing (aquifers) and non water-bearing units (aquitards). The interior portions of both the Santa Clara Valley and Llagas Ground Water Basins have confined zones, where fine-grained alluvium form a confining layer over the deeper aquifer zones. Coyote Valley is unconfined. Larger creeks generally produce larger fans with more permeable beds, while smaller creeks generally produce smaller fans with less permeable beds.

The interior portion of the Santa Clara Valley Ground Water Basin is highly stratified. The elevated edges of the basin are less stratified. Individual streams contribute alluvium to individual units, however in the valley floor, the streams and fans merge to form an aggregate of alluvium from the surrounding units.

Santa Clara Valley Ground Water Basin:

San Francisquito Creek Fan: The San Francisquito Creek Fan is a moderate size fan descending from the northwestern edge of the county to the baylands. As San Francisquito Creek lies on the county boundary, the northern portion of this fan is located in San Mateo County, and is not under District jurisdiction. For this reason, only the southern part of this fan was delineated.

Western Small Fans: Creeks in these small fans deposit silt- and clay-rich alluvium and do not contribute significant amounts of clean coarse alluvial materials. This hydrographic unit is not hydrogeologically significant. The Western Small Fans represent smaller interfan areas between larger fans and are considered "dead areas." Water does not easily percolate or significantly recharge the aquifers underlying these fans.

Northwestern Fans: This hydrographic unit is of moderate significance and comprised of several, small adjacent fans. Creeks located in this fan include Matadero, Barron, Adobe, and Permanente.

Stevens Creek Fan: Stevens Creek Fan is a major alluvial fan extending from the southern end of Cupertino to the baylands. Unconfined conditions encourage direct recharge and indirect recharge from subsurface inflow along Stevens Creek. Natural recharge is supplemented by District artificial recharge efforts.

Southwestern Fans: This hydrographic unit is of moderate significance and comprised of several, small adjacent fans. Creeks located in this fan include Calabazas, Saratoga, and San Tomas Aquinas. The fan formed by Calabazas Creek contains a higher percentage of fine-grained material and is therefore of lesser hydrogeologic significance than the fans formed by Saratoga and San Tomas Aquinas Creeks. The fans formed by Saratoga and San Tomas Aquinas Creeks are mostly unconfined and much recharge occurs here. Natural recharge occurs throughout the unit primarily during the rainy season along the creeks, and is supplemented by District artificial recharge operations.

Los Gatos Creek Fan: Los Gatos Creek Fan is a hydrographic unit of major significance. At the fan's apex, ancestral Los Gatos Creek eroded a sizable canyon that is now filled with permeable materials. Cobbly alluvium and high infiltration rates characterize Los Gatos Creek as one of the most significant rechargers on the west side of Santa Clara Valley Ground Water Basin. Ground water recharge occurs naturally along Los Gatos Creek and artificially through extensive District recharge operations.

Ross Creek Fan: The Ross Creek Fan is a small interfan area of little significance. It is located between two major fans – Los Gatos Creek Fan and Guadalupe River Fan.

Guadalupe River Fan: The Guadalupe River Fan is a hydrographic unit of major significance. Ancestral Guadalupe River splayed alluvial materials over an extensive lateral area and deposited extremely permeable sediments at its mouth. Currently, the District conducts artificial recharge operations in this fan.

Almaden Valley: The Almaden Valley is not considered an alluvial fan nor an area of significant ground water recharge within the Santa Clara Valley Ground Water Basin. The alluvial fill in this tributary subbasin is relatively shallow and was deposited primarily from Alamitos Creek. Bedrock islands protrude above the alluvial fill along the boundary between Almaden Valley and the Guadalupe River Fan.

Coyote Creek Fan: The Coyote Creek Fan is a hydrographic unit of major significance. High-energy ancestral flow allowed for the deposit of gravel east of Oak Hill. The District conducts extensive artificial recharge operations in the upper portion of this fan.

Eastern Small Fans: Creeks in these small fans deposit silt- and clay-rich alluvium and do not contribute significant amounts of coarse alluvial materials. These fans are considered "dead areas." Water does not significantly recharge the aquifers underlying these fans.

Upper Penetencia Creek Fan: Although the Upper Penetencia Creek Fan is moderate in size and significance, it is considered the most significant hydrographic unit on the eastern side of the Santa Clara Valley Ground Water Basin. The District conducts artificial recharge in the upper portion of this fan.

Northeastern Fan: This hydrographic unit is comprised of several, small adjacent fans. Berryessa Creek is the major contributor of coarse alluvium in this unit, with smaller tributaries such as Calera and Scott Creeks depositing silt- and clay-rich alluvium. This unit is considered a "dead area." Water does not significantly recharge the aquifers underlying this unit.

Basin Interior: The Basin Interior is one of the most significant hydrographic units in the basin. This unit is characterized by thick water-bearing sediment layers due to deposits from Coyote Creek, Los Gatos Creek, and Guadalupe River. Historically, coarser materials splayed along the elevated lateral edges of the basin, while finer materials splayed outward in alluvial fans that formed an alluvial plain. Near the baylands, the aquifer materials are finer and more stratified. This hydrographic unit has alternating layers of coarse- and fine-grained alluvium that form a confining condition. Recharge occurs on three sides – along the western, eastern, and southern boundaries. There are distinct upper and lower aquifer zones in the Basin Interior that are separated by non water-bearing units, or aquitards. A leaky clay cap approximately 20 to 100 feet thick and 100 to 200 feet below ground surface occurs along the northern boundary of the unit and extends to downtown San Jose. Salt water intrusion occurs in some areas of the Alviso and Palo Alto baylands, but is not considered a problem in Santa Clara County due to the thick aquitards. Most of the pumping in this unit is of the deeper, confined aquifers.

Coyote Valley:

Coyote Valley: Coyote Creek is the major contributor of alluvial material in this valley. Coyote Creek enters from the east side of the Diablo Mountain Range, and flows along the elevated eastern edge of the valley. Fisher Creek flows down the axial trough. Water generally moves northwest, down the valley. Depth to water varies from about 10 to 40 feet below ground surface. Recharge is primarily through deep percolation of runoff from Coyote Creek. Secondary recharge is from other tributaries, rainfall, irrigation returns, and subsurface inflow along the lateral edges of basin. Ground water discharges into Coyote Creek just upstream of the Coyote Narrows.

Llagas Ground Water Basin:

Confined Zone: Llagas, ancestral Coyote, and Uvas Creeks are the major contributors of alluvial material in the Confined Zone. In this area, continuous aquitards of varying thicknesses occur at 20 to 100 feet below ground surface and separating this zone into upper and lower aquifers. There are numerous aquifers in the lower zone and the ground water flow is primarily southeast, towards Pajaro River, except where the regional gradient is interrupted by pumping troughs. Recharge is mainly from surficial sources and subsurface flows from the forebay. The Purissima Formation underlies the southern end of the basin.

Northern Forebay: Most of the alluvial materials in this hydrographic unit of major significance originated from ancestral Coyote Creek. A great amount of alluvium originated from Llagas Creek and small tributaries (small, ephemeral drainages) along the lateral edges of the basin. There is a ground water divide under the topographic divide along the northern boundary of this unit. The District conducts artificial recharge operations at Main Avenue, Madrone Channel, and along the upper reaches of Llagas Creek.

Western Fans: Most of the alluvial materials in this hydrographic unit originated from small tributaries (small, ephemeral drainages) along the western edges of the basin. Creeks in these small fans deposit silt- and clay-rich alluvium and do not contribute significant amounts of coarse alluvial materials. These fans are considered "dead areas." Water does not easily percolate or significantly recharge the aquifers underlying these fans.

Western Forebay: Most of the alluvial materials in the Western Forebay originated from Uvas Creek and other small tributaries (small, ephemeral drainages) along the lateral edges of the basin. The District conducts artificial recharge operations in this unit along Uvas Creek.

Eastern Small Fans: Most of the alluvial materials in the Eastern Small Fans originated from small tributaries (small, ephemeral drainages) along the lateral edges of Llagas Ground Water Basin. Creeks in these small fans deposit silt- and clay-rich alluvium and do not contribute significant amounts of clean coarse alluvial materials. These fans are considered "dead areas." Water does not easily percolate or significantly recharge the aquifers underlying these fans. The depth to the main pumping zone in this unit is deeper than most other pumping zones in the basin.

Bedrock Areas:

Santa Clara County Uplands: This area is bedrock, and topographically-unsuited for the formation of alluvial fans.

Bedrock Islands: Numerous bedrock islands are scattered throughout Santa Clara County. The largest bedrock island is Oak Hill, which is located in the Guadalupe River Fan. Other bedrock islands are found in the Western Small Fans near Saratoga Creek, along the boundary between the Ross Creek Fan and Guadalupe River Fan, along the boundary between the Guadalupe River Fan and Almaden Valley, in the interior of Almaden Valley, in the Eastside Small Fan (of Santa Clara Valley Ground Water Basin) near Thompson Creek, in Coyote Valley, and in the Western Fans and Confined Zone of Llagas Ground Water Basin.

REFERENCES

California State Department of Water Resources. Evaluation of Ground Water Resources, South Bay: Bulletin 118-1. Appendix A: Geology. 1967.

Clarke, W.O. Ground Water in Santa Clara Valley, California. United States Geological Survey. Water-supply Paper 519. 1924.

Helley, E.J. and Brabb, E.E. Geologic Map of Late Cenozoic Deposits. Santa Clara County, California. United States Geological Survey. Basic Data Contribution 27, San Francisco Bay Region. Environment and Resources Planning Study. 1971.

Hoose, Seena. Engineering Geologist, Santa Clara Valley Water District. Personal Communication. July 1996.

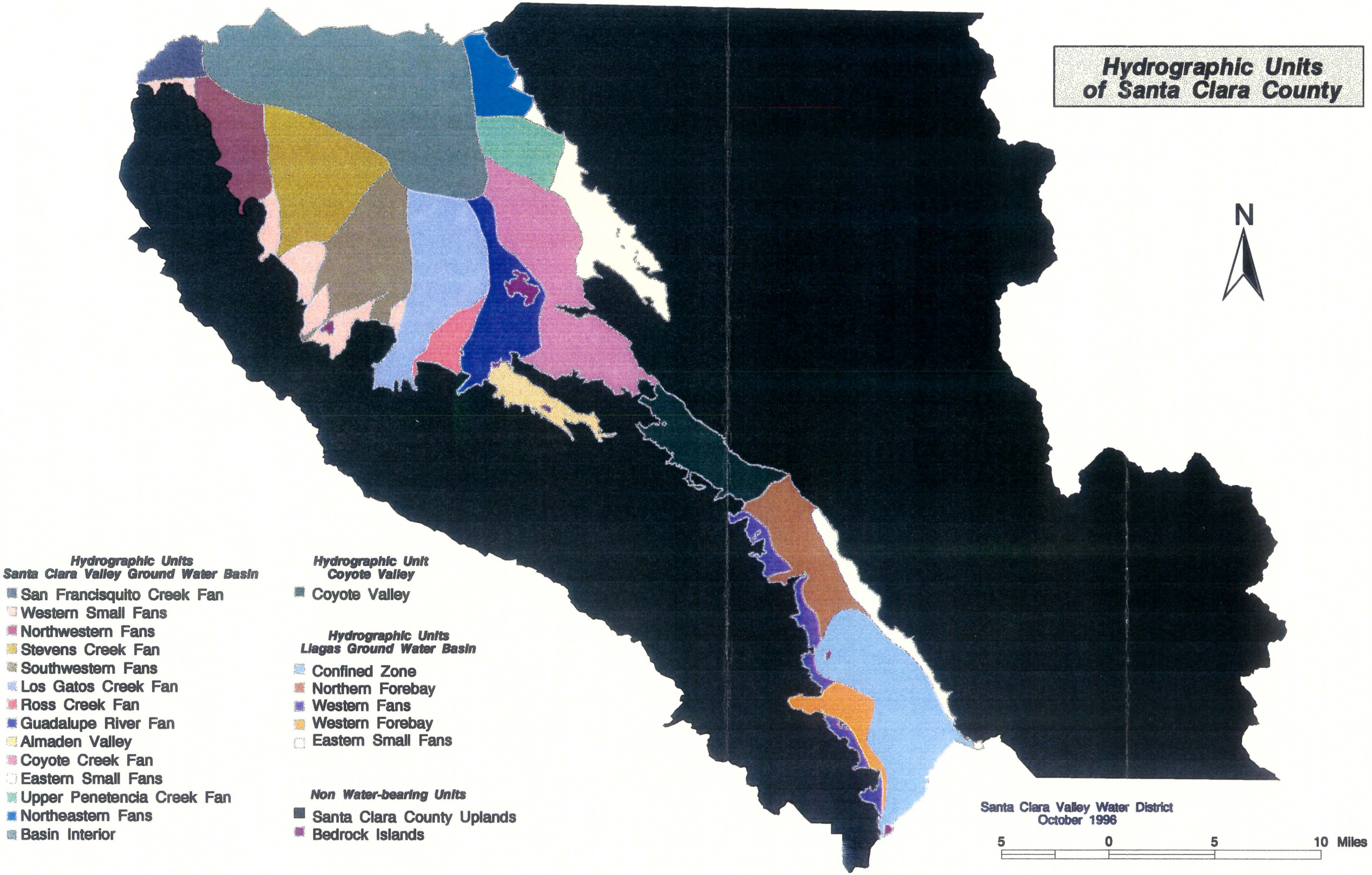
Iwamura, Tom I. Engineering Geologist, Santa Clara Valley Water District. Personal Communication. July-September 1996.

United States Geological Survey. USGS 7.5 Minute Quadrangle Maps in Santa Clara County, California. 1980.

Wilson, L.D. and Iwamura, T.I. Standards for the Construction and Destruction of Wells and Other Deep Excavations in Santa Clara County. Santa Clara Valley Water District. 1989.

ATTACHMENT A
Map: Hydrographic Units of Santa Clara County

Hydrographic Units of Santa Clara County



Santa Clara Valley Water District
October 1996